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ABSTRACT

This environmental education guide, developed by American Forests, includes five lessons created to help teachers use "Growing Greener Cities," a tree-planting handbook. The lessons are designed to teach students the role trees and forests play in cities. Lesson one begins with an introduction, several preparatory exercises to orient students to trees and the urban forest, and a set of experiential activities. Each lesson contains pertinent information, including readings from "Growing Greener Cities." Lessons two through five follow the same pattern as lesson one, without the preparatory exercise. The final lesson includes tree-planting suggestions for teachers, students, and schools. (Author/MCO)

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ENVIRONMENTAL EDUCATION GUIDE

AMERICAN FORESTS

Citizens caring for trees and forests since 1875

SE 053 851

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Growing Greener Cities

An Environmental Education Guide

AMERICAN FORESTS
1516 P Street, NW
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Co-author of *Growing Greener Cities*

Growing Greener Cities:

An Environmental Education Guide

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PREFACE:

Since 1875, AMERICAN FORESTS has worked to ensure for society the countless benefits of trees and forests. Through a variety of communications and educational media, AMERICAN FORESTS provides citizens, decision-makers, teachers, and students with useful, practical information about trees and forests and their link to environmental quality. The goal of this educational effort is to provide an introduction to ecology, and help people take an active role in maintaining and improving the quality of their environment.

The urban forest, the forest we live in, is a logical starting point for environmental improvement because we are the dominant animals in this ecosystem. We decide which trees will be removed during land development; we plant trees to replace those that have been removed or have died; and, because city conditions are hard on trees, we are responsible for caring for them.

Unfortunately, the condition of our urban forests has quietly and steadily deteriorated. A 1991 AMERICAN FORESTS survey of twenty major city forests showed that the average life of an urban tree is just 32 years -- much shorter than that of a tree in a rural forest. Many cities cannot provide the routine care needed to maintain a healthy urban forest and remove more trees than they plant. Unless people take action, the future of our urban forests and our global environment will be grim. "Thinking globally and acting locally" is a lesson worth learning early in life.

Knowledge and leadership can reverse this trend, and education is the key to helping people improve the quality of our urban forests. This environmental education guide and the accompanying book *Growing Greener Cities,* enables teachers to introduce concepts of trees, urban forests, and related energy and environmental issues into their on-going science programs. With these materials, students and educators open the door to the natural world around us and take an important step toward a healthier environment.

R. Neil Sampson
Executive Vice President
AMERICAN FORESTS

Growing Greener Cities:
An Environmental Education Guide

INTRODUCTION: The *Growing Greener Cities Environmental Education Guide* includes five lessons -- a total of 13 activities -- created to help teachers use *Growing Greener Cities*, a tree-planting handbook, to supplement their teaching resources. The lessons are designed to teach students about the vital role trees and forests play in cities. Trees make cities livable places by cooling them during hot weather, thus reducing the need for electricity, and by providing countless environmental and social benefits. In addition to teaching students about the importance of urban forests, this guide helps exercise students' observational, problem solving, math, and language-arts skills.

We encourage you to take advantage of local resources as you use this guide. Local urban foresters, county extension agents, utility foresters, urban ecologists, city planners, and others can bring valuable expertise to your classroom.

Lesson 1 begins with an introduction and several preparatory exercises to orient students to trees and the urban forest. A set of experiential activities follows. Each lesson contains pertinent background information, including the necessary readings from *Growing Greener Cities*. Lessons 2 through 5 follow the same pattern as Lesson 1, without the preparatory exercises. The final lesson includes tree-planting suggestions for teachers, students, and schools. **The teacher is encouraged to use the guide as an adaptable resource, adjusting the activities to best meet students' educational needs.**

1. **What is a Tree?** -- This lesson explores the physical and functional characteristics of trees, and encourages careful observation.

2. **The Value of Trees and Forests** -- This lesson explains the importance of trees and forests, especially to people.

3. **Welcome to the Urban Forest** -- This lesson introduces the concepts of interdependence and community, focusing on the urban ecosystem and our role in it.

4. **Energy, the Environment, and You** -- This lesson explores the impact fossil-fuel burning, the greenhouse effect, energy sources, and energy conservation have on an individual as well as a community.

5. **Grow a Greener City** -- Using information introduced in the first four lessons, this final lesson provides activities to directly engage students in tree planting and community action.

LESSON 1:

What Is a Tree?

Goal:

To have students learn about trees as living organisms. This includes tree physiology, anatomy, and response to seasonal and other events.

Background:

We all recognize trees -- we know the smell of pines and the relief of cool shade on a hot summer day, the sound of wind-rustled leaves and the joy of jumping into piles of leaves in autumn. But do we really know trees? How they live? Why they are important?

Find a tree and look closely at it:

> What kind of tree is it? Is it coniferous, like pines and cedars, with evergreen needles or leaves? Or is it deciduous -- does it drop its leaves in autumn like some oaks and maples?
>
> What creatures live on or in it? Trees can house an abundance of plant and animal life, such as opossums, raccoons, porcupines, squirrels, chipmunks, birds, small plants, mushrooms, insects, and mosses.
>
> How does it live? What does it eat? Like other plants, trees make their own food from sunlight. With the energy from the sun, trees combine water and carbon dioxide to make sugar. This process is known as photosynthesis. A tree uses this sugar along with water and nutrients from the soil to grow.

This lesson includes preparatory exercises followed by two activities: "Journey to the Center of a Tree," designed to introduce students to tree anatomy and physiology with a historical perspective, and "Stake a Claim on a Tree," which asks students to observe a tree for changes over an extended period of time.

Resources:

Growing Greener Cities: A Tree-Planting Handbook

p. 10 Ecology and Carbon
p. 14 Natural Air Conditioners
p. 39 The Shape of Trees
p. 70 The Anatomy of a Tree
p. 82 Trees, Hydrocarbons, and Air Pollution

Preparatory Exercises

A. Tree Talk *The following questions may be used in an oral or written quiz format to generate an initial discussion of trees.*

Prerequisites: none
Time: 5 to 10 minutes

1. Name a tree you have seen.
2. Name a tree that drops its leaves in the fall, appears to be dead through the winter, and then looks alive again in the spring.
3. Name a tree that looks alive all year long.
4. Name a tree with needles instead of leaves.

B. Tree Terms *The Glossary (p. 51) provides a starting point for key vocabulary about trees. You may wish to have students conduct a word search or create a crossword puzzle.*

Prerequisites: none
Time: 30 to 40 minutes (minimum)

Examples of key words are:

cambium	phloem	silviculture
canopy	roots	trunk
heartwood	sapwood	xylem

C. Tree Memory *Have students write a paragraph of 75–100 words about a tree in their neighborhood or near their school. Have them include answers to the questions below. The students will be able to compare their "memory" of a tree from this exercise with actual observations of a tree later in this lesson.*

- How tall is it?
- How big around is it? At the base of the trunk? At the top? A single branch?
- What is the shape of the tree?
- How far do the branches spread?
- What size and shape are the leaves?

- Are there flowers? Describe them.
- Is there fruit? Describe it.
- What color is the tree?
- What animals live there?
- Are there other plants living on the tree?
- Is the tree healthy? How can you tell?
- Do people use this tree? How?
- How are people like trees? Unlike trees?

ACTIVITY 1: ***Journey to the Center of a Tree***

Subjects: Botany, tree physiology, geometry, social history, natural history.

Skills: Observation, analysis, hypothesis, evaluation, mapping, and oral and written communication.

Prerequisites: *Before carrying out this activity, teachers and students should read* Growing Greener Cities, *"The Anatomy of a Tree" p. 70–75.*

Time: Two 40–minute class periods (minimum).

Materials: A cross–section of a tree or a core sample from a tree. A tree (or limb) cross–section usually can be obtained from a local tree–trimming service, forest industry, or utility company that is clearing or trimming trees from power or telephone lines. Other resources include your state or county Department of Natural Resources, Forestry or Extension Service.

Background: People record events through oral stories, physical monuments, and written accounts. History helps us learn about the present--where we are today--by looking at what happened in the past. [*Teacher should give an example of relevant historic/current perspective as appropriate to age, location, and issues of students.*] Trees, like people, keep track of history. Trees record weather, physical events, and the passage of time.

In order to interpret the history of a particular tree, we must first look at the method a tree uses to record its history. A tree records "memories" within the structure of its trunk. Everything that impacts the tree throughout its life, from insects, cars, or disease to heat, nutrients, or flooding, will leave a mark. Impact may be positive, resulting in rapid growth, or negative, resulting in slower growth.

A tree records its growth in its rings. Rings are a function of temperate zone seasonal changes -- trees growing in the tropics do not have annual growth rings because their growth is fairly constant. A growth ring usually appears each year in dry weather, with the outer growth rings being the most recent. When growth rings are very close together, the tree grew very little. When rings are widely spaced, the tree grew very quickly.

The authors of *Growing Greener Cities* explain the trunk's role in a tree's function and growth as follows (p. 74–75) :

> The trunk is the arterial system--like our arteries and veins--that transports these materials to the leaves in the outer layers of the tree trunk and inner layers of the bark. Just beneath the bark is the cambium, the "cell factory" of the tree. Cells that form outward from the cambium layer develop into the phloem (the layer of tissue which transports the food up and down the trunk) and the bark. Cells that form inward from the cambium become xylem, or sapwood, which conducts the water up and down the trunk.
>
> As the tree grows outward, older xylem stops its transport function and becomes heartwood. In some cases, this heartwood may actually rot away completely, leaving a perfectly healthy hollow tree with only the living outer rings performing all the necessary vital functions of the trunk. It is here, in the outer layers of wood, that in a large tree hundreds of gallons of water and nutrients are sucked up from the roots, and tons of sugar–laden sap are pushed down from the leaves in a pump–like action. This massive flow of fluids makes the tree the largest vascular creation on the planet.
>
> A tree grows upward much like adding an ice cream cone to an existing stack of other cones. A branch that grows out of the trunk at a height of say, 4 feet from the ground will certainly grow in diameter, as will the trunk itself, but the branch will remain the same distance from the ground for the duration of the tree's life.
>
> The same goes for injuries--whether initials carved on a tree trunk or slashes from a mower. Trees overcome injuries and fight off infections by sealing off the affected part. Whether wounded by a badly pruned branch or the attack of a bark beetle, a tree will carry its scars for the rest of its life.

Foresters often use a tool called an increment borer to extract a core of wood from standing trees, logs, poles, or timbers. Using this technique, the age and condition of trees can be determined without destroying the tree. *Note: Increment boring should only be done by professionals. Because it wounds the tree, increment boring should not be performed indiscriminately on healthy trees. To obtain a wood core, you should contact a forestry agency, a professional forester, or your local natural history center.*

Procedure:

1. Obtain a cross–section or core sample.

2. Measure the diameter and circumference of the cross–section. Discuss how the circumference of the tree relates to its age and growing conditions. Calculate the surface area of the cross section ($A= \pi r^2$).

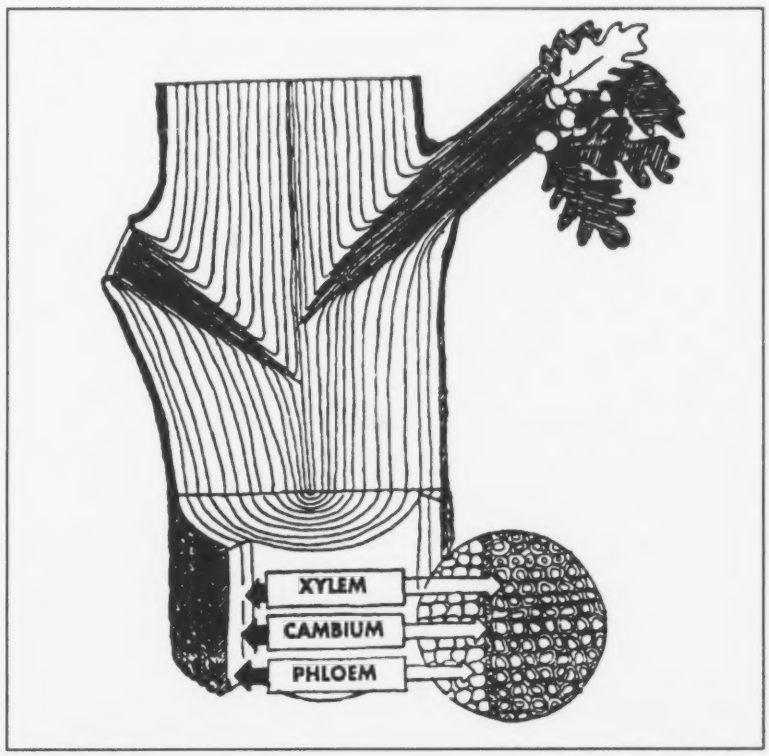
3. Identify similarities and differences in sizes of and spaces between tree rings. Discuss with students possibilities for these differences.

   - What do you think widely spaced growth rings mean for the tree?
   - What natural factors might have affected the tree's growth?
   - What man-made factors might have affected the tree's growth?

4. Have students create a timeline for the life of the tree. Start with an estimate of when the tree germinated (when it began to grow from a seed), and continue to the current date. Charting the timeline in five-year increments may be sufficient if the tree is relatively old.

5. Include memorable points along the timeline, relative to the students' point of view:

   - Birthdates.
   - Year they began school.
   - Year the town or community was settled.
   - Year the state entered the union.
   - Year of the first presidential election they remember.



ACTIVITY 2: ***Stake a Claim on a Tree***

Subjects: Climatology, ecology, local natural history.

Skills: Record-keeping, comparison, analysis, evaluation, independent study.

Prerequisites: None.

Time: 20 to 30 minutes, once a week.

Materials: Paper, pens, **How Big Is Your Tree?** worksheet, notebooks or journals.

Background: The natural environment changes over time. Rainfall, soil conditions, and other physical factors affect a tree from year to year. These climatic and physical changes can affect when a tree drops its leaves in autumn, how long it is dormant in the winter, and when it begins to grow again in spring. Some trees give the appearance of never visibly changing (except in size), yet these trees continually drop and replace leaves.

1. Have students individually, or as a class, "adopt" a tree, and describe why they chose that particular tree. Ask the students the following questions:

   - Do you have a favorite tree? If you do, why is it your favorite?
   - Do you sit in the shade of your favorite tree? Do you climb it?
   - Can you see it from your window, or do you see it as you walk or ride to school?
   - If you don't have a favorite tree, why not?
   - Do you think trees are important? Why or why not?

2. Ask students to create a journal to record observations of their adopted tree. This logbook will allow students to keep track of events in the life of the tree. Students may begin by answering the following questions. Encourage students to add their own questions.

   - How tall is the tree? (use the guide **How Big Is Your Tree?**)
   - How big around is it? At the base of the trunk? At the top? A single branch?
   - What is the shape of the tree?
   - What size and shape are the leaves?
   - Are there flowers? Describe them.
   - Is there fruit? Describe it.
   - What colors are the tree?

- What animals live there?
- Are there other plants living on the tree?
- Look at parts of the tree through a magnifying glass. What do you see?
- Is the tree healthy? How can you tell?
- Do people use this tree? How?

3. Ask students to observe their tree during each season and record their observations in their journals. If each year's class monitors the same trees, a history of these trees will develop. Questions students might answer:

   - Autumn: How has the tree changed? What color are the leaves? Does the tree still have leaves? Are there any missing or new visitors to the tree?
   - Winter: What changes do you notice about the tree? Are there any missing or new visitors to the tree?
   - Spring: Do you see buds on the tree's branches? Small leaves? Are there now any missing or new visitors to the tree?

4. Have students measure their tree *(see **How Big is Your Tree?** on the following page)*

Extension:

Ask the students to draw a picture of their tree and collect a leaf from it. Have students press the leaf to preserve it.

To make a leaf press:

- Place several sheets of newspaper on top of a wooden board.
- Place leaves on the newspaper, alternating newspaper and leaves. It is helpful to write the name of the tree on the newspaper next to each leaf.
- Cover the last leaf with several sheets of newspaper and place a second board on top.
- Place books, bricks or other heavy objects on top of your press. Allow the leaves to dry in the press for several days.
- Carefully remove the leaves from the press and glue each leaf to a piece of paper. Needle-like leaves (particularly short ones) are difficult to press, and often crumble.
- Once the leaves are attached to the paper, cover with clear contact paper with the tree's name, location, and date of collection.
- Collect the sheets in a ring binder. Now you have a classroom leaf guide!

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(Note to teachers: The ***How Big Is Your Tree?*** *worksheet is based on* AMERICAN FORESTS' *National Register of Big Trees Program. For information about how to nominate a champion tree, students may write to* AMERICAN FORESTS, *Big Trees Program, P.O. Box 2000, Washington, D.C., 20013. The* ***National Register of Big Trees****, which lists national champion trees by species, and includes color photographs, is available for $7.95.)*

WORKSHEET **How Big Is Your Tree?**

This measuring guide is based on AMERICAN FORESTS' National Register of Big Trees program. In this program, people from across the country measure trees to find "champion" American trees, the largest of their species, to be placed in the Register.

Materials: Tape measure (or string with lengths marked off), pencils.

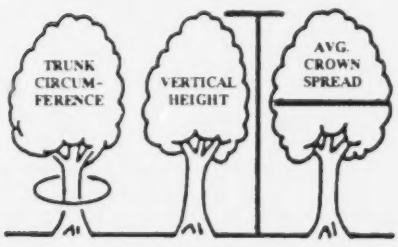
Trunk:
Measure the tree's "waist," or circumference, at 4 1/2 feet above the ground.

Height:

1. Holding the pointed end of a pencil as far from your eye as the length of the pencil, move backward from the tree (carefully!)
2. Close one eye and stop moving backward when the pencil appears to be as tall as the tree.
3. Ask a classmate to measure the distance between you and the tree's trunk. This is roughly the height of the tree. This method of estimating a tree's height is called triangulation (based on the laws of geometry).

Crown:

1. Outline the tree's crown by placing the pointed end of pencils into the ground underneath the outer tips of the tree's branches.
2. Measure the distance between the two pencils that are the farthest apart. Write down the number.
3. Measure the distance between the two pencils that are the closest together and still on opposite sides of the tree. Write down the number.
4. Add the two numbers and divide by two. This new number is the tree's average crown spread.



Total Points:
Trees are compared by their total points. To find your tree's total points, add: trunk circumference measurement (in inches), height (in feet), and 1/4 of its average crown spread (in feet). This number is the total points for your tree.

LESSON 2:

The Value of Trees and Forests

Goal:

To have students explore the roles of trees in different forest ecosystems and to have students consider and attempt to measure economic and other values of trees and forests.

Background:

In urban as well as rural areas, trees form communities with plants, animals, and nonliving things such as soil and water. This community is called a forest. There are six major forest types around the world, five of which can be found within the continental U.S., Hawaii, Puerto Rico, and Alaska.

Cool Coniferous Forests are found in high altitudes of the northern New England Appalachian Mountains, Alaska, and much of northern Canada. The trees found in these areas include several species of spruce, pine, fir, hemlock, and northern white cedar. Some deciduous trees such as red oak, birch, beech, and sugar maple can also be found here.

Temperate Mixed Forests are divided into three types and zones. The first type is the eastern deciduous, located in the eastern U.S. from the Atlantic Ocean to the Midwest. The trees included in this group are oak, elm, beech, ash, and maple, as well as some coniferous trees -- pine, fir, spruce, and hemlock.

The second type of temperate mixed forest is the Rocky Mountain coniferous forest, located in the mountainous western U.S. from Canada to Mexico. The ponderosa pine, Englemann spruce, white fir, and larch are the common trees in this group.

The third type of temperate mixed forest is the Pacific moist coniferous forest, found on the west coast of the U.S. and Canada, from Alaska to northern California. Included in this group are the sequoia, Douglas-fir, Sitka spruce, and western redcedar.

Dry Forests are primarily located in southern California, southern Arizona, New Mexico, and parts of Texas. The types of trees typically found in these forests are the mesquite and live oaks.

Warm Temperate Moist Forests can be found in the southeastern states. The trees most suitable to this climate include the longleaf pine, slash pine, shortleaf pine, loblolly pine, bald cypress, and many different species of deciduous trees.

Tropical Moist Deciduous Forests are located on the southern tip of Florida, in Hawaii, and Puerto Rico. The types of trees includes the gumbo-limbo, tamarind, wild mahogany, and poisonwood.

A unique forest "type," which cuts across all other forest classifications, is the **Urban Forest**, presented in Lesson 3. Urban forests may have begun as one of the six forest types, but because of urban heat and pollution, and people's tree preferences, many original tree species no longer exist in our cities. In the urban forest community, human beings are the predominant species. People determine the quantity and type of tree species. Other factors affecting tree health include soil compaction, pollution, and the "heat island" effect of urban areas. Trees such as locust, gum, cypress, and certain oaks often grow in urban areas because they are suited to compacted soils and conditions that are hotter and drier than those in the surrounding countryside.

Trees and forests are important to human beings for many reasons. Trees use carbon dioxide and release oxygen in the process of photosynthesis. Trees also provide food, income-producing materials, and recreational opportunities. Some tree and forest values are easier to determine than others. For example, the value of white oak lumber can be determined by the demand for it at the lumberyard, but the value of a tree for climbing or the value of forests in maintaining water quality may be difficult to put in monetary terms.

This lesson has two activities. In the "The Webs of Life" students explore the role of trees in ecosystems and the interdependence of the living and nonliving components of an ecosystem. "What's a Tree Worth?" makes students aware of economic and other values of trees and forests.

Resources: *Growing Greener Cities: A Tree-Planting Handbook*

p. 12 A Windfall from Trees
p. 15 The Oasis Effect
p. 18 Slowing the Wind and Rain
p. 20 Fighting A Numbers Game

ACTIVITY 3: ***The Webs of Life***

Subjects: Ecology, urban ecology.

Skills: Analysis, identifying relationships.

Prerequisites: Working knowledge of the components of "habitat" and "ecosystem."

Time: At least two 40-minute class periods.

Materials: Large ball of twine or yarn; cards to label as ecosystem components.

Background: Life in all forests is "interdependent." Plants use sunlight and soil nutrients to grow. Animals eat the plants for food, spread the seeds, and fertilize the plants to speed growth. When plants and animals die, they decay with the help of microorganisms and insects, and return important nutrients to the soil, which also helps new plants grow. This "food chain" represents the flow of energy through a forest. Sunlight enters the forest and is used by trees and other plants to grow and produce food (leaves, fruits, bark). Animals obtain energy by eating the plants. This "energy cycle" is basic to all ecosystems.

Because the urban forest is largely determined by human beings -- its main inhabitants -- we affect its natural cycles. We alter the "energy cycle" by removing trees and plants that have died, by introducing new species, and by preventing certain animals from living in our cities. We import energy from other ecosystems to supply our needs. Our hard-surfaced, black-topped roads absorb heat and allow water to run off, making our cities hotter and drier than they would be otherwise. Soils, compacted from years of construction and heavy machinery, make it difficult for plants' roots to grow and obtain nutrients.

By restricting the diversity of plant life in our cities, and changing natural cycles of energy, water and nutrients, we have created an environment that can be discouraging to trees and the wildlife associated with them.

Procedure:

1. Split the class into groups of eight or ten, and have students sit in circles, either in chairs or on the floor. Give each student an index card labeled with a component of a forest ecosystem. Try to include a variety of both living and nonliving components. Begin the activity with simple, connected variables (soil, water, air, tree, bird), then increase complexity by becoming more specific (oak tree, rainfall, stream, squirrel).

2. Give one student the ball of twine or yarn, and ask how he or she is related to another "piece" of the ecosystem. If the first student is "rain," he or she may choose "soil" because rain keeps soil moist so plants can grow. The student could also say "fish"; rain affects water levels in streams and lakes. Encourage the students to articulate the reason for the connection. Any connection is acceptable, and finding indirect connections is encouraged. When the student chooses a connection, he or she should hold onto the end of the string, wrap it around his/her hand a couple of times to keep it secure, and give the ball of string to the person who is labeled as that connection.

3. Continue this process, and a "web" will appear in the circle. Focus on how the components are connected. Ask the students what would happen if a piece of the ecosystem were lost.

   - Are some components more important than others?
   - What may be the long-term effects of an increase or decrease in one of these pieces?

This next twist in this activity will illustrate the concept of the urban forest and the important role of human beings in the urban ecosystem.

4. Ask the students to describe an "urban forest."

   - How are the trees in a local park, or the trees on the street or around the school different from trees "in the woods"?
   - Do trees in the community provide all of the benefits and products of the trees in rural forests? *(See Activity 4: What's a Tree Worth?)*
   - Do you think trees in cities need more attention from people than trees in rural areas?

5. Introduce new cards labeled with urban ecosystem components, and resume the activity. Continue to use the original cards, but include "sidewalks," "buildings," "telephone lines," and other items found near trees in cities. Be sure to include "people" cards in various roles (a person playing in a park, driving a bus, cooking dinner). Discuss the interaction of the man-made and natural components of the urban ecosystem. *You may wish to remove any cards representing wildlife not present in the urban forest, or first discuss whether these components fit.*

ACTIVITY 4: ***What's a Tree Worth?***

Subjects: Ecology, botany, social studies, economics, fine arts.

Skills: Value clarification, analysis, evaluation, observation.

Prerequisites: None.

Time: Two 40-minute class periods.

Materials: Copies of **What We Get From Trees** handout and **Tree Evaluation form.**

Background: Trees provide many values. These include:

Environmental Values

- **Clean water** -- The hair-like root fibers of trees help filter groundwater, trapping nutrients and pollutants that could contaminate it.
- **Soil protection and nourishment** -- Tree roots hold soil in place so it cannot easily be washed away by wind or water; the decaying of dead tree parts returns nutrients to the soil.
- **Storm water control** -- Leaves and branches slow the movement of rain to the ground, allowing it to soak in slowly. Without trees, heavy rains can wash soil into streams and rivers, making them shallower and prone to overflow.
- **Air quality** -- Trees provide oxygen and use carbon dioxide. They also capture particulates (dust, pollen, etc.) with their leaves.
- **Mineral and nutrient cycling** -- Through growth, transpiration, and death, trees cycle and utilize minerals and nutrients from the air, water, and soil (mostly from the soil).
- **Climate control** -- Trees moderate temperatures by working as natural barriers to wind, snow, rain, and solar rays. Through evapotranspiration, trees add moisture and cool the air.
- **Habitat for wildlife** -- Trees and forests provide homes for many different species of animals. Other plants also need trees for structural support.

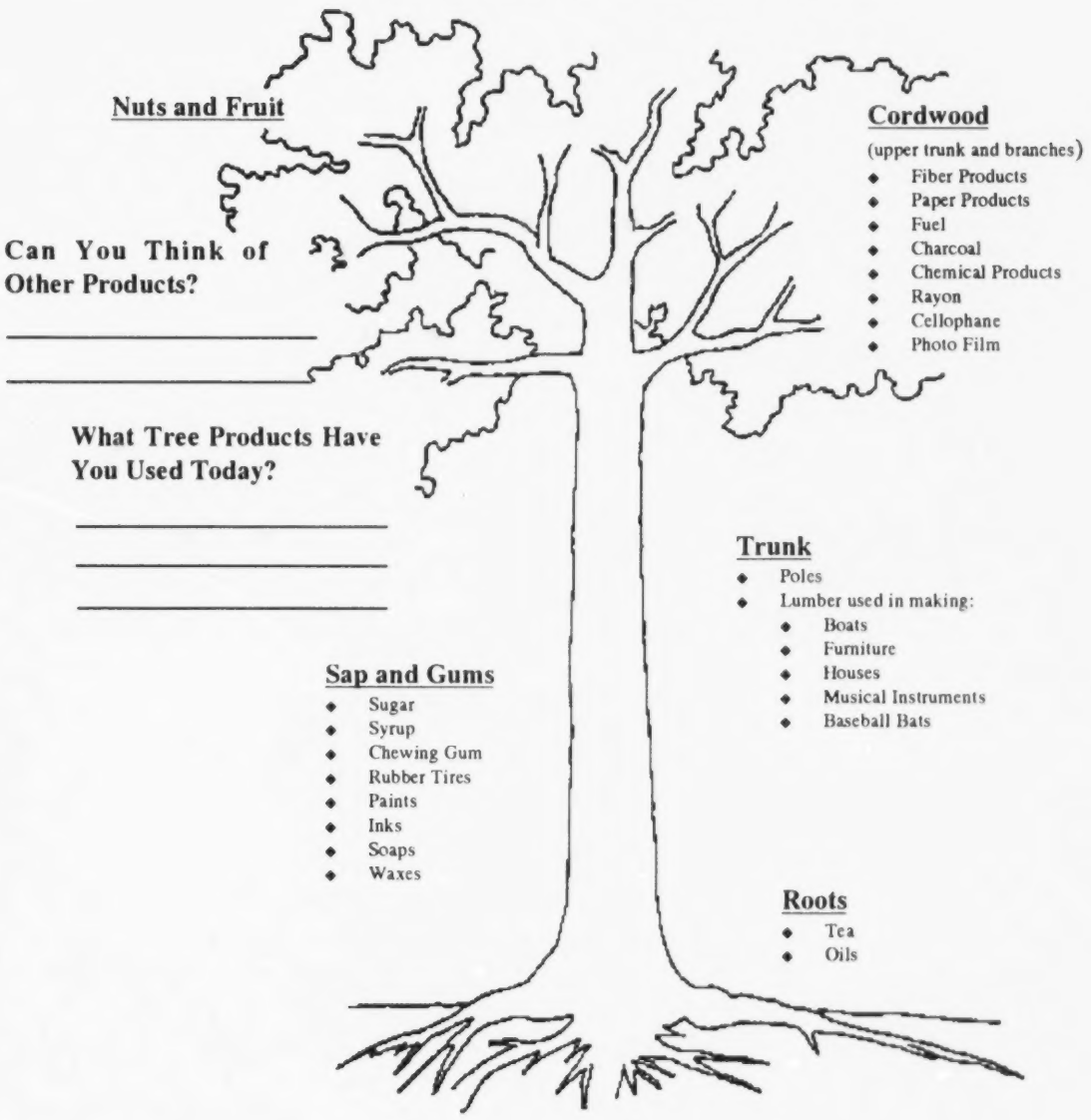
Human Values

- **Aesthetics** (beauty) -- Trees beautify urban and community areas such as parks, streets, and schoolyards.
- **Mental health** -- Trees provide natural scenery that cheers and calms us. A view of trees has been shown to speed patient recovery in hospitals.
- **Recreation and physical health** -- Forests are great places for activities such as hiking, backpacking, skiing, hunting, and bird-watching.
- **Community spirit** -- Planting and caring for community trees can bring neighbors together to improve their environment and build a sense of community and environmental stewardship.
- **Natural source of medicines** -- Trees provide substances with medicinal values, such as taxol, extracted from the bark of the yew and used in treating cancer.
- **Education** -- Forested areas offer many resources as outdoor classrooms.
- **Economy** -- Making room for trees in our cities provides job opportunities and a healthier environment. The forest industry also provides jobs for many people, from loggers to cabinetmakers and home builders. Trees planted for energy conservation help consumers save money.
- **Forest Products** - More than 5000 products and by-products come from trees. They include wood products, paper products, sap products, and foods. You use them every day.

Procedure:

1. Ask students to suggest how trees or tree-related products fit into their own lives. Remind them of the natural environment, home, school, food, music, art, transportation, and recreation. Have students read the **What We Get From Trees** handout.
2. Have students evaluate the tree they adopted in Activity 2 for economic and environmental benefits, using the **Tree Evaluation form**. Discuss with students their rankings of tree values on the form. Have students include this form in their logbook.

What We Get From Trees



(This diagram is based on "What We Get From Trees," a poster available from the USDA Forest Service (see References and Resources)

TREE EVALUATION FORM

(Evaluate your adopted tree for these benefits, by ranking them from 1 to 7. Assign a 1 to the value most important to you, and a 7 to the least important.)

__ **Air Quality:** Wipe the tree's leaves with a damp white cloth. Are the leaves dirty? If so, the tree is cleaning particulates from the air.

__ **Flood Water Control:** When it rains, does the ground underneath the tree get wet as quickly as open, uncovered ground? If not, the tree is slowing water, preventing erosion and flooding.

__ **Temperature Control:** Is it cooler under the trees in the summer than in an open area? What about in the winter -- is it warmer under the tree? If so, the tree is moderating local temperatures.

__ **Wildlife Habitat:** Are birds, insects, animals, and plants visiting or living on or in this tree? If so, the tree is providing homes, food, and resting places.

__ **Forest Products:** Do you collect fruit or nuts from the tree? Do you burn fallen branches in your fireplace? Might you cut the tree down to build something with the wood? If so, the tree is providing you with food, fuel, or building materials.

__ **Recreation:** Do you use the tree for recreation? How?

__ **Other:** In what other ways is this tree important to you?

LESSON 3:

Welcome to the Urban Forest

Goal:

To have students discover the forest in which they live, including the value of urban trees and the student's role in the urban forest.

Background:

Imagine you're in an airplane, flying from a forested countryside into a city. As your plane ascends, you can see the rural forest around you -- land so thickly covered with trees of all sizes, it seems carpeted with leaves. As the plane gets closer to the city, the trees become less frequent; by the time you reach the downtown area, there are only a few, young trees.

Urban forests have been divided by experts into four major zones: suburban fringes, suburbs, city residential, and city center (*Growing Greener Cities, page 23*). The age, health, and number of trees in these zones decreases as you move from the suburban fringe into the city center.

Human beings play a critical role in the urban forest. We decide which trees will be removed during land development and plant trees to replace ones that have been removed or have died. Because city conditions are hard on trees (*Growing Greener Cities, pp. 20–22, 24, 26*), we are responsible for their care.

This lesson has three activities. "Treeless City," helps students understand the values of trees in urban areas. In "Tour the Trees" students explore and study their urban forest. "What's New in the Neighborhood?," teaches students how our land-use patterns affect our environment, particularly our urban forests.

Resources:

Growing Greener Cities: A Tree-Planting Handbook

p. 23 Getting To Know the Urban Forest
p. 27 Of Trees, Settlers, and Cities
p. 30 Seeing the Forest and Its Trees
p. 34 Step One: Exploring the Urban Forest
p. 48 Sketching It In
p. 90 City Trees at Risk

ACTIVITY 5: ***Treeless City***

Subjects: Ecology, social studies, geography.

Skills: Creative thinking, imagination, visualization, oral communications.

Prerequisites: None.

Time: Two to three 40-minute class periods.

Materials: Quiet area.

Background: It's easy to take trees for granted -- they've always been there, quietly providing many valuable services: slowing water; preventing flooding and soil erosion; stabilizing and adding nutrients to the soil; providing habitat, food, shade, shelter, recreation, and beauty. But what if there were no trees? What would our world be like? Could we live without them?

Procedure:

1. *(The teacher leads the class through this journey.)* Sit back, relax, close your eyes and come with me on a journey to a strange and different world. Imagine taking a walk down a street on a warm summer day. Everything looks pretty and fresh. Overhead, leafy trees are giving you plenty of nice, cool shade. You hear birds happily chirping high in the branches. The air smells fresh and clean. Off in the distance you see gently rolling green hills. A sparkling stream runs near you. You think you will go fishing later. People are setting up tables in a nearby park to enjoy a picnic.

   The neighborhood is quiet and peaceful today.

   But wait! Something strange is happening. You turn a corner, and a whole different scene appears. The air is hot, and you cannot find a spot of shade anywhere. Chirping birds and scurrying squirrels are fleeing, because they have no place to live.

   The ground looks sunbaked and dry. The neighborhood doesn't look very pretty because everything is bare. Dust and soil fly through the air and make it hard to breathe. The wind blows all the time.

You look at the hillsides in the distance. They are brown and bare, and covered with gullies. When it rains, water rushes down these hillsides, carrying lots of soil with it. The soil ends up everywhere, much of it collecting in streams and lakes. You wonder if the soil buildup is what has been killing fish and making the little stream in your neighborhood flood its banks.

People in the parks are putting beach umbrellas over their tables to shade their picnics. You hear humming noises everywhere. Air conditioners are working overtime as people try to keep cool.

What has made such a difference in your world? You have the feeling something important is missing--something that used to prevent and correct some of these problems. What is it? What do you think?

What is a world without trees?

A world without trees would be a barren world. Giant dust storms would roll across the countryside blowing away precious topsoil and choking people, plants, and animals. Sunbaked fields could no longer grow enough food to feed the world's population. Hillsides would wash away, clogging rivers and streams with soil and silt.

Without trees, we would have little protection from summer heat and cold winter winds. Air conditioners would burn precious energy 24 hours a day in the summer, and furnaces would work overtime in winter. People would live much of their lives indoors because life outdoors would be too uncomfortable.

2. Have students describe and identify locations for each of the following situations in the U.S. and throughout the world -- past, present, and future. Look at urban, suburban, and rural settings for each scenario. Discuss why the area is treeless. Has it always been treeless, or was it caused by people or climatic factors?

Blowing Soil
Without trees or other vegetative cover, wind easily picks up exposed topsoil. Dust clouds fill the air. What negative effects occur?

Unprotected Farmland
Without trees to serve as shade and windbreaks, crops, livestock, barns, farm homes and other buildings catch the full strength of wind and full heat of the sun. What results?

Dirty, Flood-prone Rivers
Without trees to stabilize the soil, erosion from hillsides can choke streams, killing fish and destroying wildlife habitats. The eroded soil raises the river beds. How would this make the river more likely to flood? What happens to surrounding lands?

Overheated Cities
Without trees, our streets, buildings, and parking lots soak up the sun's heat and raise the overall temperature. No trees means nothing absorbs carbon dioxide, methane, or carbon monoxide. What does this do to air quality?

Rapid Runoff
Without trees and other vegetative cover, the soil on hillsides is easily washed away. Rain flowing on the surface picks up speed and gathers more soil with each inch of slope, carrying topsoil and nutrients, pesticides, herbicides, etc. How does that affect the soil and water quality of the ecosystem? What does that mean in economic terms for the community relying on the ecosystem?

Gullied Land
Without tree roots to hold the soil in place, gullies eat their way into pastures and crop fields. In a suburban setting, gullies creep under fences, foundations of buildings, and roads. How does this affect land usage?

Degraded Habitat
Without trees, tree dwellers such as birds, squirrels, and insects would have nowhere to live, could not escape from enemies, and might have difficulty obtaining food. Without trees, especially in the tropics, other plants, fungi, and bacteria would not have nutrients, protection, or a place to grow. How does this impact the entire ecosystem?

3. Have students imagine a degraded habitat, and a healthy or ideal habitat. Discuss these questions:

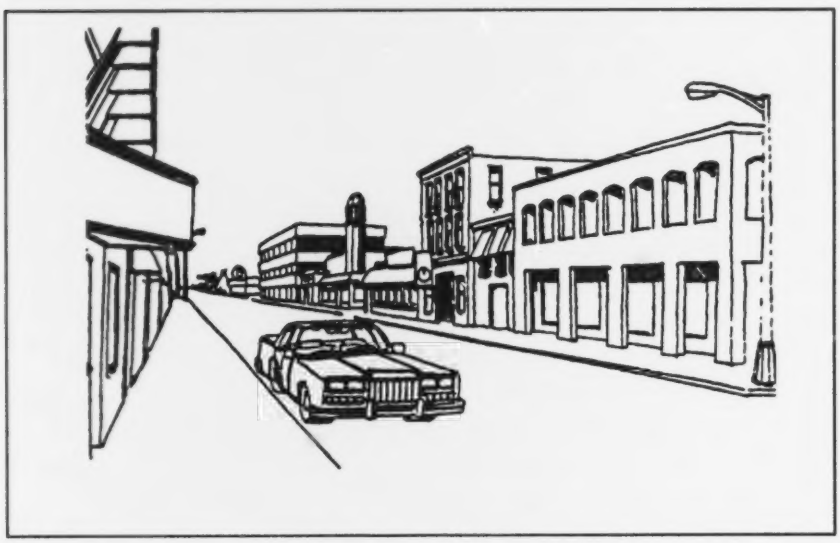
   - Do all healthy ecosystems look the same?
   - Is a desert a healthy ecosystem?
   - Could an area have lots of trees and still be a damaged ecosystem?

The students can illustrate two contrasting habitats in several ways:

- Have students write paragraphs describing two habitats. They may write about areas they know, places they have read or heard about in the media, or fictional places.

- Have students draw or paint their interpretations of an unhealthy and a healthy ecosystem. Again, these pictures can be based on real or make-believe places.

- Have students create collages of unhealthy and healthy ecosystems. They may cut out scenes from magazines or newspapers and add their own artwork.



ACTIVITY 6: ***Tour the Trees***

Subjects: Science, social studies, education.

Skills: Research, observation, planning, oral and written communication.

Prerequisites: None.

Time: Two to three 40-minute class periods.

Materials: A tree identification guide; copies of the **Tree Tour** handout.

Background: "Until you really know the condition of your urban forest and the state of the environment in which it exists, you cannot take appropriate action to improve either one." (*Growing Greener Cities, page 89*)

In 1991, AMERICAN FORESTS conducted a survey of 20 major city forests. It found the average life of a city tree to be just 32 years, much shorter than that of a tree in a rural forest. The survey also revealed that many cities remove more trees than they plant. Regular tree care is needed to help improve the condition and life span of our urban forests. In addition, by planting more trees in our cities, we can help fill those empty spaces along our streets.

By exploring your urban forest, you'll learn more than just what kinds of trees are out there. You'll learn about your local environment, its health, and what you can do to improve it.

Procedure: Ask students, as individuals or in small groups, to write scripts for use on a tour of neighborhood trees by another class or an outside group. The neighborhood might be local residential, in a downtown area, at a park or arboretum, or simply on the school grounds. The general objective is to help others become more aware of the urban forest and its contribution to our lives.

The students must think about the audience for whom they are developing this tour. What are the knowledge and skill levels of those taking the tour? Do your tourists have a scientific interest in the urban forest, an economic interest, or do they just think trees are pretty? Remind students to be conscious of the safety concerns when someone is taking the tour. The students should also keep in mind the attention span of younger children. Encourage them to think about the ways people learn -- by seeing, doing, or listening. Trial runs for the class can be useful before finalizing the script. The tour should include the following information:

1. Each tree's location

2. Each tree's common name.

3. Each tree's growing cycle. (Does it shed its leaves and grow new ones each year or keep its leaves?)

4. A description including some details about leaves, flowers, fruits, seeds, etc. (Or one unique or interesting feature of a tree that will help someone remember it -- a sycamore has peeling bark, a ginkgo loses all its fan-shaped leaves in a single day.)

5. The relationship of the tree with other organisms, including people.

6. Who takes care of the tree.

7. Each tree's animal, bird, and insect inhabitants. Can you see any? How do do you know whether they have been in contact with the tree?

8. Each tree's size and general health. What are the signs of a healthy or un healthy tree?

9. Each tree's future. How old do you think the tree is? If the tree is on public property, who makes decisions concerning the tree?

10. The values of this tree, or trees of this type, including environmental, social, and economic.

Encourage students to make their tours lively and interesting. They might tape record music to go along with their tour information, tell a historical anecdote about the area, or bring along a magnifying glass for looking close-up at features and inhabitants of the tree.

TREE TOUR

Tree Tour Stop #:

Location:

Common Name:

Description. (Leaves? Flowers? Fruit? Seeds? Any animal, bird, and insect inhabitants? Anything unusual about this tree? Include size, approximate age, growing cycle, and general health.)

What is the tree's relationship with other organisms, including people?

Who takes care of this tree?

What is the tree's future?

What values are provided by this tree?

On the back of this page make a sketch of the tree or its leaves.

ACTIVITY 7: ***What's New in the Neighborhood?***

Subjects: Civics, social studies, geography, natural history.

Skills: Research, analysis, comparison, evaluation.

Prerequisites: None.

Time: One to two 40-minute class periods plus outside research.

Materials: Copies of pre-1960 and current aerial photographs or maps of the town or a neighborhood. Check with your city planning office, local real estate company, or your local library.

Background: While the populations of most countries are increasing, in a few countries, the population is actually declining. Shifts in population are also occurring, as more and more people move from rural areas into cities. In the United States, the population is shifting from the Northeast and the Midwest to the South and West, according to the 1990 Census. Forests and other natural resources can be greatly affected by population changes and shifts.

Procedure:

1. Have students compare a pre-1960 aerial photograph or map with a current one. Have them answer the following questions:

   - How has your city, town, or county changed since 1950?
   - Has farmland been converted to suburbs or been reforested, either deliberately or through neglect?
   - What changes have occurred in roads and public transportation?

2. Have students gather information about population projections and local land use by talking with a city planner or other local government official, or by reading local newspapers. Have them answer the following questions:

   - How have population changes affected the environment?
   - What changes in land-use are projected for your area?
   - Is the population likely to increase rapidly?
   - If so, how are the demands for housing, schools, roads, libraries, and solid waste disposal going to be met?
   - Are there any projects underway or proposed that are controversial (for example: a rail system, a shopping mall, a highway, or a landfill)?
   - What effect could these projects have on the environment?

LESSON 4:

Energy, the Environment, and You

Goal:

To have students study how trees help cool urban areas and buffer unfavorable climatic conditions. Students will research different energy sources, investigate their personal energy consumption, and adopt personal energy conservation practices.

Resources:

Growing Greener Cities: A Tree-Planting Handbook

p. 8 Global Warming
p. 11 Janitors of the Air
p. 12 A Windfall from Trees
p. 15 The Oasis Effect
p. 41 Planting Trees with Impact: Energy Conservation
p. 43 To Lend a Little Shade

Background:

Our environment influences our energy choices. People who live in the northern United States use more energy for heating during their long winters. People in the southern United States use energy for air conditioning during their sweltering summers. Cooling our urban areas, which are two to eight degrees warmer than the surrounding countryside (a phenomenon called the urban heat island effect), also requires energy.

In turn, our energy choices affect our environment. No energy choice is without its costs, both environmental and economic. Knowing these costs and being a wise consumer can help reduce environmental problems associated with our energy consumption.

Two easy ways to reduce energy consumption while improving our environment are energy-conserving tree planting and light-colored surfacing. As few as three shade trees properly placed around buildings can reduce energy demand for heating and cooling by as much as half. Maximizing the potential albedo, or solar reflectivity, of our cities by surface color lightening could reduce energy use by 30 to 50 percent.

This lesson has five activities. "Living in a Greenhouse" helps students understand the greenhouse effect; "Gotta Have Energy," teaches students about energy sources, both renewable and non-renewable; "Become a Savings Sleuth," shows students how to identify their personal energy consumption and environmental costs; "Keeping it Cool" changes students' awareness of and behavior toward energy conservation; and "Cooler by Design" has students investigate the role of trees and light-colored surfaces in energy conservation.

ACTIVITY 8: ***Living in a Greenhouse***

Subjects: Climatology, ecology, physics, and chemistry.

Skills: Research, analysis.

Prerequisites: Minimal chemistry or general earth science.

Time: Two 40-minute class periods.

Materials: Magazines, newspapers, glass aquarium, thermometer, and light source.

Background: It is now recognized and accepted that, because of human activities such as energy production, industrialization, and deforestation, conditions are being created that are affecting climate. Global climate change could be the result of uncontrolled human activities.

What is the greenhouse effect and how does it work?

The greenhouse effect is a natural process that allows life on the planet. Both naturally occurring processes and human activities emit gases into the atmosphere. These gases act like the glass in a greenhouse, allowing the shorter wavelength, ultraviolet rays of the sun in, but trapping the long wavelengths of infrared radiation and reflecting them back to earth. The result is an envelope of "greenhouse gases" forming around the earth, trapping heat and warming the planet's lower atmosphere. We need the greenhouse effect to keep the earth's temperature warm enough for us to live, but problems occur when the chemicals get out of balance.

What are these greenhouse gases and where do they come from?

About 80 percent of these gases come from the burning of fossil fuels, which releases carbon dioxide (CO_2) into the atmosphere. Other gases, including nitrogen oxides (NO_x), methane (CH_4), chlorofluorocarbons (CFCs), and ozone (O_3) also contribute to the global-warming problem.

Man has substantially increased the release of greenhouse and other gases through energy production, industrialization, biomass burning, and deforestation. In nature, greenhouse gases are given off by lightning, naturally occurring fires, volcanic action, the weathering of certain bedrock, and the bacterial decomposition of organic matter.

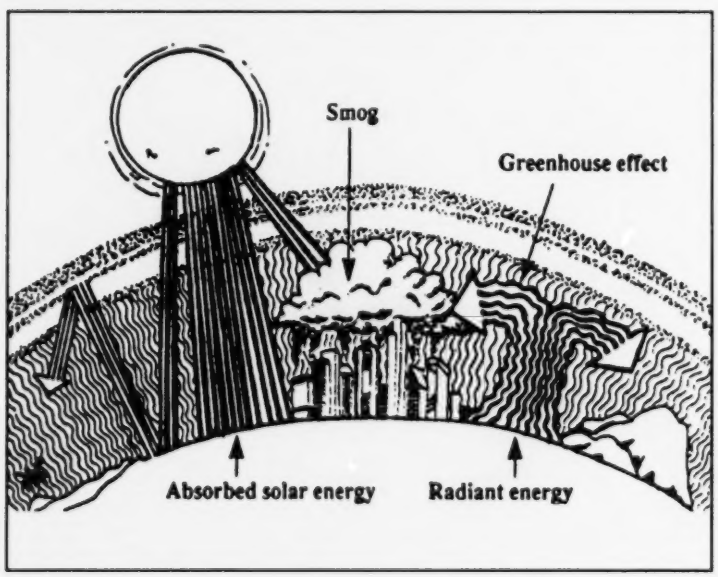
Carbon dioxide emissions are principally a by-product of fossil-fuel burning. However, deforestation now accounts for about a quarter of the current CO_2 levels, because when forestland is cleared for agricultural use, it is burned, releasing CO_2 into the atmosphere.

Nitrogen oxides are another type of greenhouse gas that is rapidly increasing in the atmosphere. These gases are released by burning fossil fuels such as gasoline, oil, and coal.

Methane is produced primarily through the bacterial decomposition of organic matter -- particularly in places like landfills, swamps, and the digestive systems of animals. However, biomass burning, fossil-fuel production, and organisms in the ocean emit methane, too.

Chlorofluorocarbons (CFCs) are man-made compounds used as refrigerants, cleaning solvents, and raw materials for making plastic foam. Although much less common than CO_2, CFCs are 15,000 times more efficient at trapping heat.

Ozone forms a beneficial shield against the sun's ultraviolet rays at high altitudes (in the stratosphere). But ozone serves as a heat-trapping greenhouse gas at much lower altitudes. Ozone is a pollutant when trapped at low levels in city air. It too is a by-product of the burning of fossil fuel. Lightning forms ozone naturally by splitting oxygen molecules and allowing these oxygen atoms to combine with other oxygen molecules.



Procedure:

1. Discuss, as a class, the types of gases that make up our atmosphere. Make a list of the more common gases and the activities or events that form them.

2. Discuss the concept of global climate change and the greenhouse effect. Ask students what the greenhouse effect is and how it works. Have the class illustrate the greenhouse effect.

3. Ask students to name common gases that make up the air we breathe. Have students name and list human activities or natural processes that form these gases. Generate a list from newspapers and magazines.

4. Illustrate the concept of the greenhouse effect using an aquarium, thermometers, and a light source.

Extension:

Set up a bulletin board to show the names and symbols of gases and the natural processes or man-made activities that form each gas. Pictures found in magazines or newspapers can be used.

ACTIVITY 9: ***Gotta Have Energy***

This activity provides a good opportunity for a utility company representative to speak to students about the kinds of energy the utility uses, and what is being done in terms of alternative energy research and development. Encourage the students to ask questions, and remind them that different groups and individuals hold different attitudes toward energy use.

Subjects: Math (basic), environmental science.

Skills: Research, analysis.

Prerequisites: None.

Time: Outside research, and at least two 40-minute class periods for sharing information.

Materials: Energy Worksheet.

Background: You use energy every day. If you have ever been in a blackout during a storm, you know the ways we depend on electrical energy. Lights, refrigerators, TVs, air conditioners, and computers all require electrical energy to run. Power plants convert energy from oil, coal, sun, and wind to electrical energy for use in our homes and factories.

Energy for motorized transportation comes directly from the burning of fossil fuels. All forms of motorized transportation also require fossil-fuel energy to run.

Energy comes from many different sources: oil, natural gas, nuclear fission, coal, the sun (solar energy), rushing water (hydropower), and wind. Sun, water, and wind are called "renewable" energy sources because they do not run out.

Most of the energy we use, however, comes from fossil fuels--oil, coal, and natural gas. One scientific theory holds that in prehistoric times, dinosaurs and plants died and became buried in the earth. Over millions of years, heat and pressure changed this animal matter into pockets of oil and natural gas. The plant matter turned into coal. These fossil fuels are considered "nonrenewable"; the amount we have now is all we will ever have.

If we use our nonrenewables unwisely, years from now we will one day no longer have them to fuel our cars, homes, and factories. We need to make our fuel supply last over time by conserving it. Another reason to conserve our nonrenewable forms of energy is that most of the world's oil is located outside the United States. We depend largely on fuel bought from foreign countries, and this dependence can be very expensive.

Procedure:

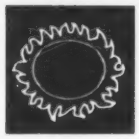
1. Discuss these questions in class:

   - How many different types of energy can you identify?
   - Which of these do you use in your own life? How often?
   - What kinds of energy does your electric utility company rely on?
   - Most utility companies rely on fossil fuels, but other sources are being used to some extent.

2. Have students individually or in small groups research an energy source. Sources include solar (passive and active), wind, hydropower, geothermal, natural gas, coal, biomass, nuclear, and hydrogen. The students should find out basics about how their source works; whether it is used currently or is being researched for a future use, and if so, what; what kind of pollutants it emits -- including a CO_2 count; how cost-effective it is (now and in the future); and whether it is renewable.

3. Have the class create a benefits vs. costs chart to share information and compare each energy source. Good sources of information for this activity include your state energy office, the U.S. Department of Energy, and your local utility company.

Once the students have collected their information, the groups can debate the advantages and disadvantages of each source. The teacher should mediate, and present questions for the teams. The teacher will want to have students answer the questions on the **Energy Worksheet** before the debate begins. If the students have done their own research, and have it in hand for reference, the debate will be more of an intelligent trading of information than a heated but insubstantial argument.



ENERGY WORKSHEET

Benefits and Costs

1. Name of energy source (wind, hydropower, nuclear, solar, etc.):

2. Is this an energy source you use every day? If so, how?

3. How is this energy source harnessed to supply electricity?

4. What pollutants are emitted by the development and use of this energy source (carbon dioxide, nitrogen oxides, sulfur dioxide, sludge, radioactive waste, etc.)?

5. Are there any other environmental costs involved in using this technology? (Wind power is associated with increased deaths in birds, especially raptors. Also consider land-use requirements and any environmental costs of producing the equipment to use this energy source.)

6. Is the energy source renewable? Why?

7. Does this technology produce electricity cost-effectively? What do you think are its future possibilities?

ACTIVITY 10: ***Become a Savings Sleuth***

Subjects: Math, environmental sciences, civics.

Skills: Research, comparison, analysis, evaluation, independent study.

Prerequisites: None.

Time: Variable. Involves considerable individual, out-of-class research and class discussion.

Background: Before students can be persuaded to change their behavior toward energy use, they must understand the ways they personally use energy. They need to understand that everyone uses energy and contributes to carbon emissions. Once they identify their own uses of energy and understand why nonrenewable energy must be conserved, they can apply conservation to their own lives. Families can save energy by buying energy-efficient appliances. Large appliances such as refrigerators, air conditioners, and dishwashers are required to have labels showing yearly energy use.

Procedure:

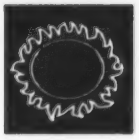
1. Have students identify ways in which their activities contribute to carbon emissions by keeping an energy diary. Students should record their energy use for one day, including the appliances used (i.e. TV, lights, microwave, car) and amount of time spent using them. Remind students about electricity gobblers such as refrigerators, air conditioners, and hot water heaters.

    - What are the benefits versus the costs of your energy usage? (For example, a car is a speedy and convenient, but gas is expensive and cars contribute to pollution.)

2. Once they have recorded their energy use, students should analyze it.

    - In what ways could they save energy?
    - What changes are they willing to make to save energy?
    - How much will these changes reduce CO_2 emissions?

3. Have students choose an appliance and compare the operating, purchase, and installation costs of different brands and models.



- How many pounds of CO_2 will the most efficient appliance save?
- What are the operating costs of the appliance? (For a coal-fueled power plant, students can assume that one pound of CO_2 is generated for each kWh of electricity. This formula varies, depending on the fuel sources for each power plant.)

4. Students also should be aware of energy-saving activities at the community, state, and national levels. Have a class discussion in which each student expresses a point of view.

   - What is your community doing to conserve energy?
   - Do you have a public transportation system?
   - Do you have a community tree planting and care program?
   - What are national programs doing to conserve energy or promote conservation? (Check out government regulations for fuel efficiency standards, alternative energy research, and energy councils. The U.S. Department of Energy and your state's energy office are good sources for this information.)

ACTIVITY 11: ***Keeping It Cool***

Subjects: Environmental science, chemistry.

Skills: Analysis, evaluation.

Prerequisites: None.

Time: One 40-minute class period.

Materials: Copy of **Keeping It Cool** game *(see Appendix)* .

Background: Few products we use or activities we engage in are directly tied to local natural resources. Food can be processed, packaged, and transported halfway around the earth. We drive or ride to school or work in vehicles manufactured thousands of miles away and powered by fossil fuels generated millions of years ago.

Manufacturing utilizes energy, and transportation consumes fossil fuels; maintaining the artificial environments in which we live and work requires substantial energy as well. For every one unit of energy used in home heating, cooling, lighting, and appliances, power plants must generate approximately 3 1/2 units. Because it takes energy to move energy, and systems are not leakproof, 2 1/2 units are lost in moving energy from generating plants to our homes.

If we conserve one unit of energy, we prevent 3 1/2 units from being generated. The CO_2 that would have been formed as a by-product of energy production would not be produced and released into the atmosphere, and thus could not contribute to the greenhouse effect.

Trees are "sponges" for CO_2 and help reduce many pollutants in the atmosphere. A healthy, growing tree uses about 26 pounds of CO_2 per year, stores the carbon in the form of wood, and returns oxygen to the atmosphere. If the wood is protected (not allowed to decompose), the CO_2 is tied up permanently. When a mature tree is harvested and the wood manufactured into furniture, building materials, or other solid-wood objects, the CO_2 is out of circulation. New trees replanted on the harvested site continue to use CO_2.

The energy we use and the ability of trees to use CO_2 may be combined to provide a blueprint for progress in the battle against potential global climate change. Individual actions that reduce energy consumption and aid in the "storage" of carbon in wood can help slow the trend. Tree planting can also help: When trees shade buildings, air-conditioner needs can be reduced by as much as 50 percent.

Procedure:

(This game is similar to BINGO.)

1. Each individual or group has a gameboard card with a number of actions displayed in various patterns.

2. The teacher or a student draws an Action Card from the pile and reads it. The first student to claim the Action Card by relating it to his/her gameboard card places it on the corresponding space. Some cards may relate to more than one square.

3. The student must provide a reasonable explanation as to why the action relates to a particular square. For example, use of flow restrictor valves will "conserve hot water," but the card also says to "find a better way," so the student may mark off either of these actions on their gameboard.

4. The first student to claim four cards in a row on their game card gets to read the next cards until runners-up are named.

Extension:

Laminate Action Cards and make them available in an activity center for students to use when other work is done.

Have students explore energy costs of other activities on their own and create new cards.

ACTIVITY 12: ***Cooler By Design***

Subjects: Physics, environmental science, geometry, architectural arts.

Skills: Research, analysis, record keeping, independent study.

Prerequisites: None.

Time: Four to five 40-minute class periods.

Materials: To carry out this experiment, students will need:

1. Four 20-by-30-inch sheets of white or light-colored foam core or cardboard
2. Scalpel or artist's knife (such as an X-Acto knife)
3. Black paint, paper, or other "surfacing" material
4. Outdoor thermometers
5. Glue, and sturdy tape (such as masking or duct tape)

Background: One important way to save energy is by landscaping with trees and other vegetation around your home. Landscaping provides an effective, natural way to prevent heat loss and heat gain in your home. When your home stays cool in the summer and warm in the winter, you use the air conditioner and heater less. Consequently, you save energy and prevent CO_2 emissions.

Deciduous (leaf-losing) trees placed on the west and east sides of a house are the most effective at shading and cooling because they block the afternoon sun, especially in the summer. Because they are bare in the winter, the trees allow the winter sun to warm the house.

If you live in a large apartment building or an area that does not have space for trees, you can still receive the cooling and shading benefits of trees. Trees planted along streets and around schools, churches, and office buildings also help conserve energy.

Another energy-saving measure that goes hand-in-hand with landscaping is light-colored surfacing. If you have ever stepped barefoot on asphalt in the summertime, you probably ran as fast as possible to the light-colored sidewalk or, even better, to a shady spot on the grass.

The street is much hotter than surrounding areas because dark surfaces absorb solar radiation, while light-colored surfaces reflect it. By lightening the colors of buildings, parking lots, and pavements, communities can reduce the amount of energy required for cooling by as much as 50 percent. A combination of trees and light-colored surfaces can make a significant difference in temperature.

Procedure:

1. Have students construct three model houses out of foam core or cardboard. The structures can be as simple or as complex as students wish, but the dimensions and features of each must be consistent (a good size is 9" wide-by-6"-deep-by-10" tall). The roof of each house must be removable. Build each on a base slightly larger than its house. The entire outer surface of one house must be black, and the other two must be white.

2. On a clear day, remove the roof and place a thermometer in each house, making sure its position is consistent in all three. Secure the thermometers with tape and replace the roof. Place the houses outside. Put the dark-surfaced and one of the light-surfaced houses together, in a spot that will get sun all day. Place the other light-surfaced house in an area shaded by trees or other vegetation. Leave the houses outside for several hours.

3. After several hours, touch the roof and exterior walls of each house.

   - Is there a significant difference in temperature?

4. Remove the roofs and check the internal temperature. Record the temperatures and compare them.

   - Is there a difference in temperature among the three houses or just between the light and dark ones?
   - What can you conclude from the outcome of your experiment?
   - How is your model similar to "the real thing"? How is it different?
   - Do you think this experiment relates to energy conservation or the urban heat island effect? How? (The heat island effect is explained on page 16 of *Growing Greener Cities*).

Extension: *This extension involves students in studying the seasonal angles of the sun, and allows them to become "landscape architects" by having them choose sites for trees around a house.*

Background: The sun rises in the East and sets in the West while slanting south at some angle as the seasons change. The sun also passes higher relative to the horizon in the summer than it does in the winter. In other words, because the angle of the sun is closer to horizontal in the winter, the sun does not seem to rise as high as it does in the summer. Where you plant your tree, relative to the position of the sun at different times of year, determines what shading, and consequent energy savings, that tree will provide throughout the year.

Materials:

1. Houses used in main activity
2. Materials for making model trees *(Encourage students to be creative. The trees must only be generally scaled to the houses and the general shape of real trees. You might suggest a large paper cup, paper-towel roll, or tree branch for a trunk and a crumpled ball of paper, ball of yarn, or paper hat for a crown.)*
3. Protractor, string
4. Flashlight

Procedure: Have students carry out the following extension, using the houses built in the main activity.

1. Mark the base of the house at each side as either east, west, north, or south. Place the house on the floor; do not move it during the rest of the experiment. Place the tree(s) on the west side of the house. Attach a piece of string to the center of the south edge of the house's base. Tie the other end of the string to a flashlight.

2. Using the protractor at a fixed position on the floor, find the number of degrees (See map below) in your area during the summer, that the sun is above the horizon. Hold the string and flashlight at that angle. With the classroom lights off, shine the flashlight at the house and mimic the sun's

east–west pattern. Try to maintain the angle found with the protractor. Notice how the tree shades the house.

- What time of day (morning, afternoon, evening) would the tree shade the house?

3. Place the tree(s) at the east and south ends of the house and repeat the procedure. Repeat the entire procedure with winter–sun angles.

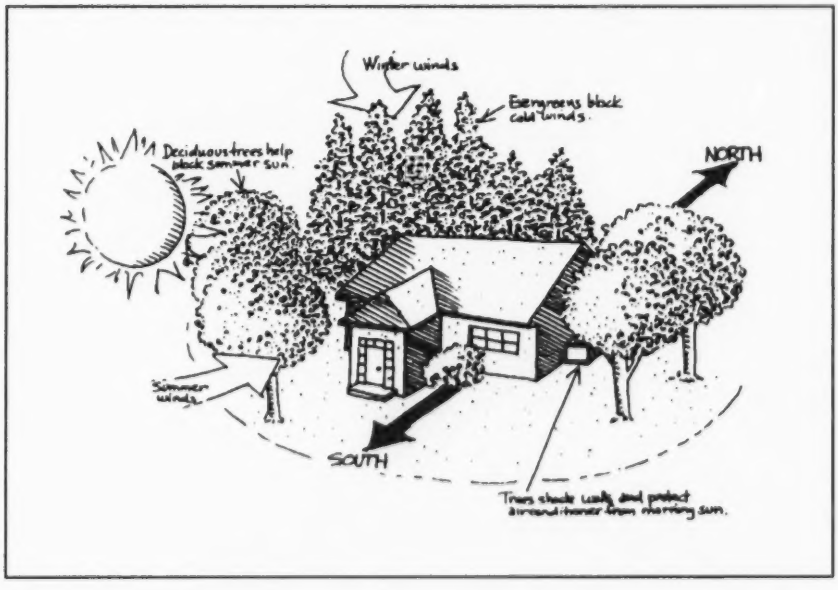
4. Draw pictures of the house with the tree's shade on it.

5. Discuss the following questions, or have students answer them in their journals used in Activity 2.

   - To shade the house from the summer sun, on which side of the house should you plant a tree? Why?
   - Where on the house do the sun's rays hit?
   - What is the difference between summer and winter shading? What effect could this have on the temperature in the house?

Extension:

Taking it home: For more information about how and where to plant trees for energy conservation, contact AMERICAN FORESTS, P.O. Box 2000, Washington, DC 20013; (202) 667–3300.



LESSON 5:

Grow a Greener City

Goal:

To have students learn how to plant and care for trees, and by doing so, improve their community's environment.

Background:

As stewards of the urban forest, we are reponsible for the quality of our environment. Unfortunately, the structures we have built -- roads, buildings, and pipes and wires (urban infrastructure) -- do not incorporate the natural cycles of energy, water, and nutrients. As a result, most of our urban ecosystems suffer from high temperatures, air pollution, and poor water quality. By planting and caring for our urban trees and forests, we can help make our cities greener and improve our environment.

This lesson has one activity. "Plant a Tree" teaches students how to plant and care for a tree, and by extension, how to care for the urban forest.

Resources:

Growing Greener Cities: A Tree-Planting Handbook

p. 51 Step Four: Preparation and Planting
p. 60 Step Five: Caring For Your Tree
p. 88 The Community Connection

ACTIVITY 13: ***Plant a Tree***

Subjects: Forestry, civics.

Skills: Research, planning, diligence/follow-through, oral communications.

Prerequisites: None.

Time: Variable.

Materials: Tree, shovels. (Ask your city forester, county extension agent, parks department, or utility company for a list of approved trees for your community. For best results, have a local forester or tree-planting organization assist with the tree planting.)

Background: Planting a tree and caring for it as it grows is one of the most important actions you can take to improve your environment. Planting trees around your home or school specifically for energy conservation has special significance. Since many of our world's greatest environmental challenges are caused by our energy use, energy-conserving tree planting can improve the local as well as the global environment.

Is there a space around your school or home that would benefit from a healthy tree? If your answer is yes, you should begin by reading *Growing Greener Cities, Part II -- Planting Your Tree*. You should follow closely the instructions for tree and site selection and preparation. Be sure to also read carefully the section on caring for your tree.

Make sure you plant the right tree in the right place. Avoid overhead and underground utilities. Remember that your job is not finished after planting -- a newly planted tree needs to be watered weekly and looked after for years.

If you do not have a suitable spot for a tree, or it is not planting season and you would like to find other ways to become involved in your community, consider these actions to improve your environment:

1. Tell others about the benefits of trees and forests, and encourage them to participate by planting and caring for trees and forests.

2. Volunteer to help your local tree-planting organization:

   - Have yard sales, bake sales, or other fundraisers to support them.
   - Start a recycling program in your classroom. Recycling can be a way to make extra money for your community organization.

3. Form your own student (and parents and teachers!) tree group at your school. Contact **Global ReLeaf** (P.O. Box 2000, Washington, DC 20013; 202/667-3300) for more information about starting your own tree-planting and care organization.

4. Attend your city or town council meeting to learn what is being done in your urban forest, what projects will affect your local trees, and how you can get involved.

Procedure:

Because the soils around most homes are compacted from construction and years of use, AMERICAN FORESTS recommends the following planting technique:

1. Mark out an area three to five times the diameter of the root ball.

2. Using a rotary cultivator or shovel, loosen and mix the soil within this area to the depth of the tree's root ball within this area.

3. Dig a shallow hole in the center of the prepared area only as deep as the root ball, setting the tree on solid ground rather than on loose soil.

4. Set the tree in the shallow hole, on solid ground. Remove and discard any wires or rope securing the burlap to the root ball. If your tree is in a container, cut and remove the container.

5. If your tree has been in a container, check for encircling roots. If the roots appear to circle the container, gently separate them and spread them into the planting hole. If the encircling roots are too large to pull apart, cut them.

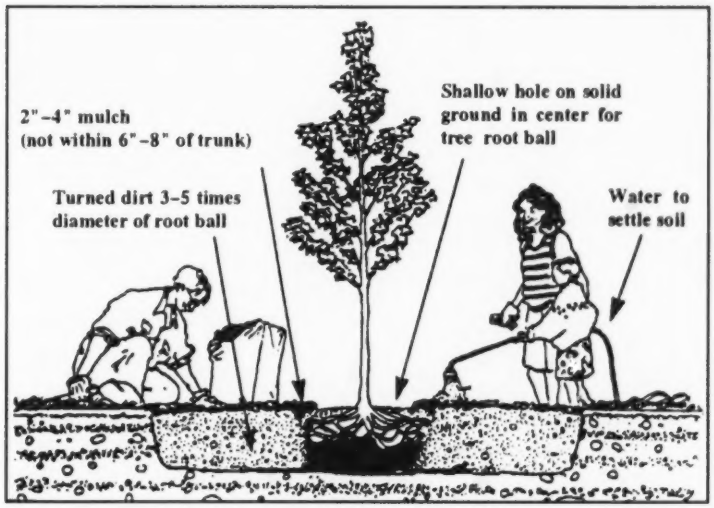
6. Make sure the top of the root ball is level with the top of the surrounding soil. If the site has poor drainage (heavy, clay soil) plant the tree so the top of the root ball is one to two inches above the surrounding soil.

7. Position the tree's main stem so that it is perpendicular to the ground, and fill in the hole.

8. Use water, not your feet, to settle the soil (this prevents overpacking).

9. Apply two to four inches of mulch over the entire prepared area. Do not put mulch within six to eight inches of the tree's trunk.

10. **Aftercare:** Give the newly planted tree a thorough watering once a week. (See "Water for Life" *Growing Greener Cities*, page 60). Trimming and fertilization are best left to tree experts, but you can watch for insect and disease problems. Wilting leaves or branches, changes in leaf color, webs, and sticky material on the leaves are signs of these problems. If you see these signs, alert your local cooperative extension service or a tree expert.



Planting a tree and caring for it as it grows is one of the most positive actions a person can take toward creating a better future. It is an empowering act, one that allows us to think globally while acting locally. This action is the central message of **Global ReLeaf**, the national action and education campaign of AMERICAN FORESTS. **Global ReLeaf** helps individuals, communities, organizations, corporations, and public officials focus on the major environmental benefits of planting and caring for trees and forests. To find out how you can get involved, write to **Global ReLeaf**, P.O. Box 2000, Washington, DC 20013.

Vocabulary

LESSON 1:	roots	canopy
	trunk	conifer
	cambium	deciduous
	sapwood	photosynthesis
	xylem	carbon dioxide
	silviculture	leaves
	phloem	crown
	heartwood	
LESSON 2:	urban forest	warm temperate moist forests
	interdependent	tropical moist deciduous forests
	cool coniferous forests	food chain
	temperate mixed forests	energy flow
	dry forests	ecosystem
LESSON 3:	suburban fringes	habitat
	suburbs	topsoil
	city residential	nutrients
	city center	remnant forests
	land development	arboretum
	land-use patterns	aerial maps
LESSON 4:	greenhouse gases	natural gas
	methane	oil
	chlorofluorocarbons	wind power
	ozone	renewable
	nitrous oxides	non-renewable
	carbon dioxide	installation costs
	greenhouse effect	purchase costs
	coal	operating costs
	solar power	conservation
	hydropower	
LESSON 5:	root ball	rich soil
	planting area	city soil
	encircling roots	drainage
	mulch	

Glossary

Albedo	The measure of the solar reflectivity of a surface.
Backfill	To return the soil to a planting area from which it was originally dug.
Bare-root seedling	A tree ready for transplanting that has had the soil removed from around its roots.
Biofuels	The product of biomass conversion; can be used directly to provide heat or electricity.
Biomass	In terms of energy production, biomass is wood and forest residues, crops and other plants, and animal manure.
Cambium	The narrow layer of cells between the bark and the sapwood. Cambium is the layer that produces new bark and new wood.
Canopy	The cover of branches and foliage formed by tree crowns.
Carbon dioxide	(CO_2) A colorless, odorless, non-combustible gas. Humans and all other living organisms give off carbon dioxide in respiration and decomposition. Trees and other plants absorb it and use it during photosynthesis. Also emitted as a by-product of burning fossil fuels.
Chlorofluorocarbons	(CFCs) Man-made compounds used as refrigerants and cleaning solvents, often long-lived in the atmosphere.
Coal	The most abundant fossil fuel, derived from prehistoric plant materials that were exposed to high temperatures and pressure.
Conifer	Cone-bearing, evergreen tree with needle-like, linear, or scale-like leaves. Found in temperate climate zones and is the most common tree in colder regions.
Conservation	The planning and management of resources so that we have continued access to these resources while maintaining their quality.
Crown	The branches and foliage of a tree.
Crown spread	The area covered by the branches and foliage of a tree.

Deciduous	Trees that shed their leaves regularly. They may be cold-deciduous and drop their leaves when the weather becomes cool (as in autumn) or drought-deciduous, dropping their leaves when the water supply is low.
Deforestation	The removal of trees and often the plants associated with them.
Desertification	A process by which land becomes increasingly unproductive and barren.
Drain sump	A pipe that helps remove excess water from a planting hole.
Energy efficient	Using energy in the most productive, least wasteful ways.
Evapotranspiration	The process by which plants lose water from their leaves; provides cooling.
Flow restrictor	A valve that reduce water flow from faucets
Food chain	The plants and animals through which energy flows. Plants make up the base of the chain, by converting energy from the sun into food. Animals make up the next steps in the chain, by eating plants or other animals to get energy.
Fossil fuels	Includes coal, oil, and natural gas. Fossil fuels are derived from prehistoric plant and animal materials that were exposed to high temperatures and pressure.
Geothermal	Energy from the earth, derived as heat.
Greenway	(Greenbelt) An area of green open space that surrounds and stretches into cities. It often contains trees and shrubs, and serves as a visual break between areas of urban buildup.
Heartwood	(Sapwood, Xylem) The central part of the tree's stem (trunk), it provides support. No longer contains any live cells.
Hydrocarbons	Compounds made of carbon and hydrogen, used to describe many fossil fuels.
Hydropower	Energy derived from the natural flow of water.
Increment borer	A tool used to extract a core of wood from a tree. Using this technique, the age and condition of trees can be determined without destroying the tree. This tool should only be used by professionals because it can allow insects and disease to enter the tree, especially in urban areas.

Interdependence	Mutual dependence.
Landscaping	The art of placing trees, plants, and other features on a piece of land.
Leaf bud	A bud from which only leaves and stems develop.
Lobes	The divisions in leaves. For example, red maple leaves have five lobes.
Methane	(CH_4) A fuel derived from the decomposition of plants; the main component of natural gas.
Microorganism	A living individual of microscopic size, such as a bacterium or protozoan.
Mulch	A protective covering, usually organic, placed around plants to keep in moisture and prevent the growth of weeds.
Natural gas	A mixture of gaseous hydrocarbons that occurs naturally in the earth.
Nitrogen oxides	(NO_x) Compounds of nitrogen and oxygen; released during fossil fuel burning.
Non-renewable	A resource that is of a fixed quantity and can be used only once.
Nuclear energy	Energy typically derived by splitting atoms (fission).
Ozone	(O_3) A form of oxygen that is chemically unstable.
Phloem	(Inner bark) The layer of cells that transports nutrients from the crown to the roots.
Photosynthesis	The process by which energy from the sun is converted into food by plants. Light energy, carbon dioxide, and water are combined to form sugar and oxygen.
Renewable	A resource that is of unlimited quantity and can be used indefinitely.
Riparian corridor	The area adjacent to a waterway such as a river, stream, or lake.
Rootball	The clump of soil containing the roots of a tree, often bound in burlap.
Roots	The underground part of the tree, they anchor the tree and absorb water and nutrients.

Rotary cultivator	A power-driven machine that uses rotating metal teeth to chop, separate and mix soil. A useful tool for large tree-plantings.
Sapling	A young tree that measures two to four inches in diameter.
Sapwood	(Xylem) the living wood of pale color next to the bark. It is formed from the cambium and conducts water and minerals from the roots to the leaves.
Seedling	A young tree shortly after it has sprouted from the seed.
Sidewalk pit	Small preserves of soil found in urban centers, usually within sidewalks. These pits are often the only place for trees in these areas, and constitute a sort of immovable "street planter."
Silviculture	The art and science of growing and harvesting forest products.
Solar energy	Energy from the sun.
Treelawn	The usually narrow area between the curb and the sidewalk.
Trunk	The main stem of a tree.
Urban forest	Created where people congregate and build communities. Since humans are the main inhabitants of the urban forest, they largely determine the tree species in this forest.
Urban heat island	The phenomenon of higher temperatures in a city compared to the surrounding countryside, caused by the combination of paved surfaces, lack of shade, and heat retention of the buildings and structures.
Utility company	A company that provides service to the public, usually electricity, gas, water, or telephone.
Well-aerated soil	Soil that has been loosened enough so that at least fifty percent of its volume is air.
Well-developed soil	Soils sufficiently weathered to have readily identifiable layers, or "horizons." An organic layer is at the top; the mineral layer is close to the bottom.
Whip	A young tree. Often one that has developed a main stem but very few branches.
Wind Power	Energy derived from the wind, usually from windmills.
Xylem	The layer of cells that transport water and nutrients to the leaves and branches from the roots.

References and Resources

References:

Learning About Energy Conservation. U.S. Department of Energy, Conservation and Renewable Energy Inquiry and Referral Service.

Global ReLeaf Classroom Guide. A program of AMERICAN FORESTS with support from Bull HN Information Systems, 1989.

Project Learning Tree. Western Regional Environmental Education Council and the American Forest Foundation, 1990.

"Cooler by Design: Community Tree Planting for Energy Conservation." Workshop sponsored by California Urban Forests Council and Sacramento Municipal Utility District, in cooperation with Western Area Power Administration, Association of Energy Engineers and USDA Forest Service, 1991.

AMERICAN FORESTS Publications

Growing Greener Cities by Gary Moll and Stanley Young

Condenses decades of experience into an easy-to-read, 128-page volume. Along with outlining the benefits of trees and forests, the book shows how to plant and care for trees. It also describes how the Global ReLeaf program is working with community groups to grow greener cities.

American Forests magazine

An informative and attractive bimonthly publication for anyone with an interest in natural resources. The magazine subscription is a benefit of membership in AMERICAN FORESTS.

Famous and Historic Trees by Charles Randall and Henry Clepper

Includes the stories of 268 well-known American trees from all 50 states. Categories cover trees associated with people, music, forestry, religion, conservation, education, and other special areas.

National Register of Big Trees

The Register is a detailed list of the largest reported specimens of 800 tree species native to and naturalized in the United States.

Proceedings of the Fifth National Urban Forest Conference
Edited by Phillip Rodbell.

Technical information about urban forest issues. These 75 easy-to-read papers are an invaluable resource for practitioners, citizen activists, and policymakers. 264 pages.

The above publications and services are available by contacting AMERICAN FORESTS, P.O. Box 2000, Washington DC, 20013. (202) 667-3300.

Other Resources

Tree Identification Guides

A Field Guide to Trees and Shrubs by Georges A. Petrides. Peterson Field Guides. 1986.

For a list of urban tree species in your area, please contact your local Cooperative Extension Service, city forester, or state Global ReLeaf coordinator. (A list of state Global ReLeaf coordinators begins on page 112 of *Growing Greener Cities*)

Sources of Additional Educational Materials

The American Forest Council, 1250 Connecticut Ave., NW, Washington, DC 20036. Publishes *Project Learning Tree*.

National Wildlife Federation, 1616 P St., NW, Washington, DC 20036. Publishes *National Wildlife, Ranger Rick, Your Big Yard, Nature Scope, International Wildlife, and Conservation Directory*.

World Wildlife Fund, 1250 24th St., NW, Suite 500, Washington, DC 20037. Publishes *Focus, WWF Letter*.

Soil and Water Conservation Society, 7515 NE Ankeny Rd., Ankeny, IA 50021. Publishes the *Journal of Soil and Water Conservation*.

U.S. Department of Agriculture Forest Service, Office of Information. P.O. Box 2417, Washington, DC 20013. *Poster* - "What We Get from Trees"

Sacramento Tree Foundation, 1540 River Park Drive, #208, Sacramento, CA 95815. Publishes *Trees, Students, Local Government* and *Seed to Seedling*.

U.S. Environmental Protection Agency, Office of Policy Analysis, Climate Change Division, 401 M St., SW Washington, DC 20460. *Cooling Our Communities: A Guidebook on Tree Planting and Light-Colored Surfacing*. This document can be ordered from the Government Printing Office, P.O. Box 371954, Pittsburgh, PA 15250-7954.

Appendix

"Keeping It Cool" Game Cards

(instructions on page 39)

Plant a Tree	Free	Choose a non-electric recreation	Conserve Hot Water
Walk, Skate, or Bike -- Don't Drive	Conserve Fossil Fuel	Find a Better Way	Protect Wood
Keep Warm Without Fuel	Make It Do -- or -- Do Without	Free	Choose a Renewable Resource
Free	Conserve Energy by Recycling	Keep Cool Without Fuel	Plant a Tree

Keeping It Cool Game

Flow restrictor valves can give good water pressure, but still use less water. Tell an adult.	Set a kitchen timer to keep your showers shorter. It will save water as well as energy.	Change clothes and hang them up when you get home. Wear play clothes more than one day. School clothes will last longer and you'll cut laundry in half.	Using warm (not hot) water to wash clothes and cool (not warm) water to rinse can cut energy costs almost in half.
A leaky hot water faucet dripping one drop per second wastes 113 gallons of hot water per month. Get a washer and learn how to install it.	Cutting food into smaller pieces before cooking saves energy and cooking time. It's a better way.	Choose a pan that fits the burner. Too big or too small wastes energy.	A whistling tea kettle lets you know when the water is boiling.
Wipe spills off stoves as soon as possible. Keep the reflectors under the burners clean to reflect more heat to pots and pans.	Walk or ride your bike to a friend's house. If he/she lives only a half mile away, you save two miles of driving and plenty of gasoline.	Read or play a board game. An hour of TV not watched will save about 1 kWh at the generating plant. Almost 2 kWh are saved if it's a tube-type color TV.	Save energy by refrigerating and re-heating leftover hot drinks like coffee or hot chocolate. Tell an adult.
Find out who else is going to the birthday party, school event, or club meeting. Carpool to save gasoline.	Don't stay in the shower too long. And don't keep it too hot.	Elevators are fine if you have heavy things to carry or far to go. If it's less than three floors and you're not carrying packages, walk!	Out of your favorite snack? Put it on the shopping list rather than suggesting a special trip to the store.

Keeping It Cool Game

Do you have to watch another video? At least walk or skate to pick it up and return it. If it's too far, plan ahead and ask someone going that way to pick it up for you.	It's cold and rainy. Curl up with a blanket on the couch and your favorite adventure book instead of turning up the heat and watching TV.	Learn to prune plants. Keep the bushes away from the walls of the house to prevent rotting of the siding and for fire prevention.	Your family likes to watch birds. Plant a dogwood or holly tree to provide shelter and food for our feathered friends.
There's no mayonnaise for your sandwhich. For one day, make do with butter, mustard, or a cheese spread. Put mayonnaise on the shopping list.	Hate to wash pots and pans? Encourage one-dish meals. It saves cooking energy and hot water for washing, too.	Feel like making something sweet to eat? Look for recipes that don't need cooking.	Does your family zip off to the grocery store six days a week? Halp make lists so shopping can be done once or twice a week. Saves money and fuel!
You and your brother want to watch different TV shows. Work out a schedule for viewing instead of asking for another TV set.	Tired of mowing the lawn? Plant a tree and use ground cover around the base. The shade will feel great when you are cooling off after mowing a smaller lawn!	Need some extra money? Check your community for recycling opportunities. There's money in "garbage!"	Does your best friend live miles away? Talk on the phone for a little while and then bike over to play with the kids in the neighborhood.
It's warm and sunny. Too hot to skate or ride bikes. Take a walk in the woods with some friends instead of turning on the air conditioner and TV.	Helping with the grocery shopping? Bring your own re-usable bag for your purchases.	It's Arbor Day! Celebrate the future by planting a tree.	Summer heat too much to bear? Drink a cool drink and settle down by a fan to play or read, instead of turning on the air conditioner.

Keeping It Cool Game

A microwave is more efficient to heat one or two cups of water. For three or more cups, the teakettle is probably more efficient.	Help to scrape and paint wooden window frames to help preserve wood and reduce decay.	Trees tie up carbon. Don't ram into them or slash them. Injured trees don't work as well.	Does Aunt Alice always send gifts you don't use? Ask her to plant a tree in your name in a national park or forest.
Recycle glass, metal, paper, and plastic. Recycling conserves energy.	Something special in today's news? Plant a tree in the school yard as a reminder to future students.	Is it too cold in the house? Put on socks, slippers, and a sweatshirt instead of turning up the heat.	Are nights too cool for you? Wear warmer PJs or out on an extra blanket.
Shower time! Don't start the water until you're ready to bathe.	Does your room get too hot? Plant a small tree outside to shade your window. If you take good care of it, it will grow faster than you might think.	Choose drinks in recyclable aluminum cans or glass, not plastic unless plastic is recycled in your community.	Most household energy is used for temperature control. Put on a sweater instead of turning up the heat if you're cold. Wear lighter weight clothing if you're hot.
25% of the energy in an all-electric home is used for cooling. Turn on a fan instead of running an air conditioner.	Evergreen trees on the north side of your home can block cold winds, helping you save energy.	Keep your house cooler by shading the walls. Deciduous trees on the west and east sides could cut your cooling bills by as much as 50%.	Light-colored or reflective paint will help keep your house cool.

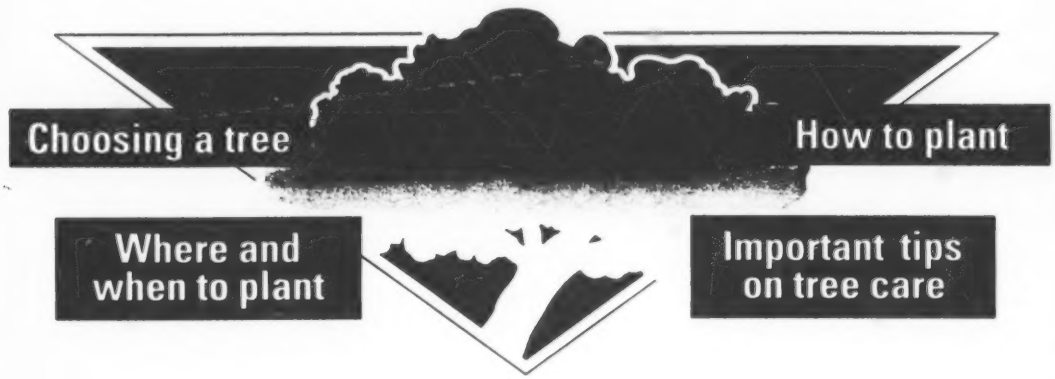
Keeping It Cool Game

Mulch or wooden sidewalks will keep your yard cooler than blacktop paths.	Wooden window frames are better for energy savings because they don't conduct heat.	All windows should be openable to allow cooling and ventilation, especially in the spring and fall.	Blinds or shutters on the outside of windows conserve energy better than those inside. Share this with an adult.
Open shades or curtains rather than turning on a light during the day.	Awnings on windows efficiently block out direct sunlight.	A jacket keeps you warm. Suggest to your folks that they get a jacket for the water heater and save money on heating bills.	Try to open the refrigerator less often. Keep a thermos of cold water or juice on the kitchen counter, instead.
Ceiling fans cost less to run than air conditioners. Turn the fan off when you're not in the room. It does no good if you can't feel the breeze.	Keep shades or curtains closed in the summer to keep heat out.	Open shades on winter days to capture solar heat.	78 degrees Fahrenheit is the recommend setting for summer. This helps conserve energy.
When boiling water in a pot or kettle, keep the lid on. This keeps moisture out of the air and cuts cooking time.	Air from a shaded yard is cooler than air from a sunny yard. Plant trees and shrubs to keep it cool.	Clogged air filters waste energy. Check furnace filters once a month. Change or clean when dirty.	Clean the drier filter after every load. Clogged filters make the drier use more energy.

Keeping It Cool Game

HOW TO GROW A GREENER CITY

This step-by-step guide gives you all the tree-planting advice you need to bring shade and greenery to your neighborhood.



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